

THE PROTURA FROM LIUPAN MOUNTAIN, NORTHWEST CHINA

BU Yun, YIN Wen-Ying
Institute of Plant Physiology & Ecology, Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences, Shanghai 200032, China; E-mail: ybu@sibs.ac.cn

Abstract The *Hua-shan entulus hua-shanensis* Yin, 1980 is redescribed, including the supplemental description of larva I, larva II and preimaginal stages as well as helmet-like appendix on the calyx of maxillary and pores on the body. *H. liupanensis* sp. nov. is described and compared with the *H. hua-shanensis*. The new species is characterized by the short maxillary gland and extremely long sensillum on foretarsus. The list of 15 species of Protura from Liupan Mountain area is also provided.
Key words Protura, new species, Liupan Mountain, China

1 Introduction

Liupan Mountain is located in Northwest China, between the border of Ningxia, Shaanxi and Gansu Provinces, which is a north-south directional mountain with altitude 2 000-2 900 m. The vegetation of Liupan Mountain is composed by temperate coniferous forest, deciduous broad-leaved forest, bush, grassland and meadow.

There is few record of Protura from Liupan

Mountain. Only one species *Nosekiella sinensis* Bu et Yin, 2008 was reported in this area (Bu and Yin, 2008). During the Summer of the year 2006, 2008 and 2009, we made three expeditions in this area in which 13 locations from one neighbor town and 12 forest farms of Liupan Mountain Natural Reserve were investigated. The information for locations collected in Liupan Mountain area is showed in Table 1.

Table 1 Locations collected in Liupan Mountain area

Locations	Date	Latitude	Longitude	Altitude (m)
Shatang	31 May 2006	35° 34' N	105° 59' E	1 950
Sutai	21 June 2008	35° 26' N	106° 11' E	2 150
Dongshanpo	23 June 2008	35° 35' N	106° 14' E	2 300
Fengtai	25 June 2008	35° 35' N	106° 12' E	2 400
Heshangpu	27 June 2008	35° 40' N	106° 13' E	2 300
Woyangchuan	29 June 2008	35° 38' N	106° 22' E	1 800
Luyuan	1 July 2008	35° 45' N	106° 12' E	2 234
Guamagou	3 July 2008	35° 46' N	106° 20' E	2 227
Qiuqianjia	5 July 2008	35° 33' N	106° 24' E	1 841
Longtan	7 July 2008	35° 22' N	106° 20' E	2 000
Erlonghe	9 July 2008	35° 22' N	106° 16' E	2 200
Hongxia	11 July 2008	35° 27' N	106° 18' E	2 082
Xixia	3 July 2009	35° 29' N	106° 17' E	2 120

Totally at least 2 000 specimens in 9 genera 15 species were collected during the expeditions. *H. hua-shanensis* is the predominant species occupying nearly half amount of the specimens; however, this species was not well described in the original paper (Yin, 1980) and the monograph of Yin (Yin, 1999) because shortage of specimens at that time. In present paper, we give a fully description of *H. hua-shanensis* based on the new collections. A new species of *Hua-shan entulus* from the material is described here. A

list of Protura from Liupan Mountain area is also provided.

2 Material and Methods

The specimens were collected using Tullgren funnels. All specimens were mounted on the slide using Hoyer's medium and dried for three days in an oven at 60 °C. Type specimens are deposited in Shanghai Entomological Museum (SEM), Institute of Plant Physiology & Ecology, Shanghai Institutes for

This study was supported by the National Natural Sciences Foundation of China (30570210, 30630010), Innovative Program of The Chinese Academy of Sciences (No. KSCX2-YW-Z-0930), and project for the insect resources investigation of Liupan Mountain (LR0810).

Received 10 Jan. 2010, accepted 25 Feb. 2010

Biological Sciences Chinese Academy of Sciences
Abbreviations used in the text see the paper of Bu and Yin (2007).

3 Description

Acerentomidae Silvestri 1907.

Tuxenentulinae Yin 1983

Huashanentulus huashanensis Yin, 1980 (Figs 1-10)

Holotype 1 male from Hua Mountain, Shaanxi Province, China, 15 Aug 1978, collected by GUO Peifu

Material examined: Sutai, 1 female (No. NX-LP-P08005), 1 male (No. NX-LP-P08006), 1 preimago (No. NX-LP-P08030), 5 mature juniors (Nos. NX-LP-P08031–NX-LP-P08035), 5 larva II (Nos. NX-LP-P08040–NX-LP-P08044). Dongshanpo, 2 females (Nos. NX-LP-P08073–NX-LP-P08074), 1 preimago (No. NX-LP-P08092). Fengtai, 1 female (No. NX-LP-P08099), 1 male (No. NX-LP-P08100), 1 preimago (No. NX-LP-P08101). Heshangpu, 2 males (Nos. NX-LP-P08115–NX-LP-P08117), 2 larva I (Nos. NX-LP-P08129–NX-LP-P08130). Woyangchuan, 1 female (No. NX-LP-P08154), 1 male (No. NX-LP-P08159). Luyuan, 1 female (No. NX-LP-P08180), 1 preimago (No. NX-LP-P08181). Guomagou, 1 female (No. NX-LP-P08185), 1 male (No. NX-LP-P08187), 1 preimago (No. NX-LP-P08205). Qiuqianjia, 1 female (No. NX-LP-P08245). Longtan, 1 female (No. NX-LP-P08252), 1 male (No. NX-LP-P08273), 1 larva I (No. NX-LP-P08264). Erbinghe, 2 females (Nos. NX-LP-P08294–NX-LP-P08303). Hongxia, 1 female (No. NX-LP-P08314), 1 male (No. NX-LP-P08308), 1 larva I (No. NX-LP-P08327). Xixia, 1 male (No. NX-LP-P09001), 1 larva I (No. NX-LP-P09006). All specimens were collected by Mr. HUANG Chengwang, CHEN Wan-Jun and BU Yun.

Diagnosis. *H. huashanensis* is the type species of genus *Huashanentulus*. It is characterized by the maxillary gland with smooth calyx and one helmet-like appendix; filiform sensillum $t-1$ on foretarsus; well developed striate band on abdominal segment VIII and 4/2 setae on urostemite VIII.

Description. Adult. Body length 1.250–1.450 mm ($n=30$).

Head. Elliptic, length 133–150 μm , width 88–110 μm ($n=30$), with one anterior middle pore. Postpseudocular seta present. Additional seta absent. Pseudoculus length 7.5–10.0 μm , width 10 μm . PR = 17.7–18.7 (Fig. 1). Canal of maxillary gland long and with blind part bulked. Calyx smooth, with one distinct helmet-like appendix. Posterior filament of maxillary gland length 30–33 μm . CF = 4.1–5.2 (Fig.

2). Maxillary palp with two seta-like sensilla subequal (Figs 3–4). Labial palp well developed with apical tuft and one leaf-like sensillum. (Fig. 5).

Thorax. Chaetotaxy as shown in Table 2. Mesonotum and metanotum with 2 pairs of anterior seta (A_2 and A_4), setae P_{1a} and P_{2a} short and small, P_{5a} short cone-shaped. Length ratio of $P_1 : P_{1a} : P_2$ on mesonotum as 2.3–2.7 : 1.0 : 3.7–4.0. Pronotum with no pores; mesonotum and metanotum with pore 1. Sternum of thorax without pore.

Foretarsal length 95–105 μm , claw length 23–28 μm , with one inner flap in some specimens. TR = 4.2–4.8. Empodium length 5.0–7.5 μm , EU = 0.22–0.25. Dorsal sensillum $t-1$ filiform, BS = 0.85–0.95, $t-2$ thin, $t-3$ small and lanceolate. Exterior sensillum a thick, surpassing base of c and d ; b filiform, surpassing base of $v-3$; c short and thick, about half length of b ; d filiform and long, nearer to e than to c ; sensillum e short and thick, reaching base of f ; f robust and long, surpassing base of claw; g short and slim (Fig. 7). Interior sensillum a' slim, distal to $t-1$; b' absent; c' thin and long, its apex surpassing base of claw. Setae δ_4 and β_1 in normal shape (Fig. 8). Length formula of foretarsal sensilla as $t-3 < c = e < b = t-1 < g < a' < a = t-2 = c' < d < f$ (Figs 7–8). Middle tarsal length 43–48 μm , claw length 18–23 μm . Hind tarsal length 48–55 μm , claw length 18–23 μm .

Abdomen. Chaetotaxy as shown in Table 2. Urotergite I with 3 pairs of anterior seta (A_1 , A_2 , A_5), with 5 pairs of posterior seta; posterior P_{1a} absent. Urotergites II–VI with 4 pairs of anterior seta; II–III with 6 pairs of posterior seta; P_{1a} and P_{4a} lacked; IV–VI with 7 pairs of posterior seta; only P_{1a} lacked. Seta P_3 on urotergite II–VI situated anterior to level of P_2 . Urotergite VII with 8 pairs of posterior seta; P_{1a} present. Accessory setae on urotergites II–VI short hair-like; on VII also short hair-like and slightly longer than on II–VI. Urotergite I with pore pm , other pores absent. Urotergites II–VI each with pores al and pm . Urotergite VII with pore pm . One membranous pore present on the anterior part of membrane between laterotergite and sternite of abdominal segments VI–VII.

Abdominal legs II–III slim, each with 2 subequal setae; the ratio of subapical seta and apical seta as 1.0 : 1.2. Accessory setae on urostemites I–VII short hair-like. Urostemites I–VII each with one middle pore. Striate band on abdominal segment VIII well developed (Fig. 6). Segment VIII with paired pore pm on urotergite which with distinct surrounding teeth. Comb on abdomen VIII posteriorly rounded and protrudes backwards with 20–22 similar teeth on hind margin (Fig. 9).

Segments IX–XI without pores on urotergites and

Table 2. Chaetotaxy of *Huashanentulus huashanensis* Yin, 1980.

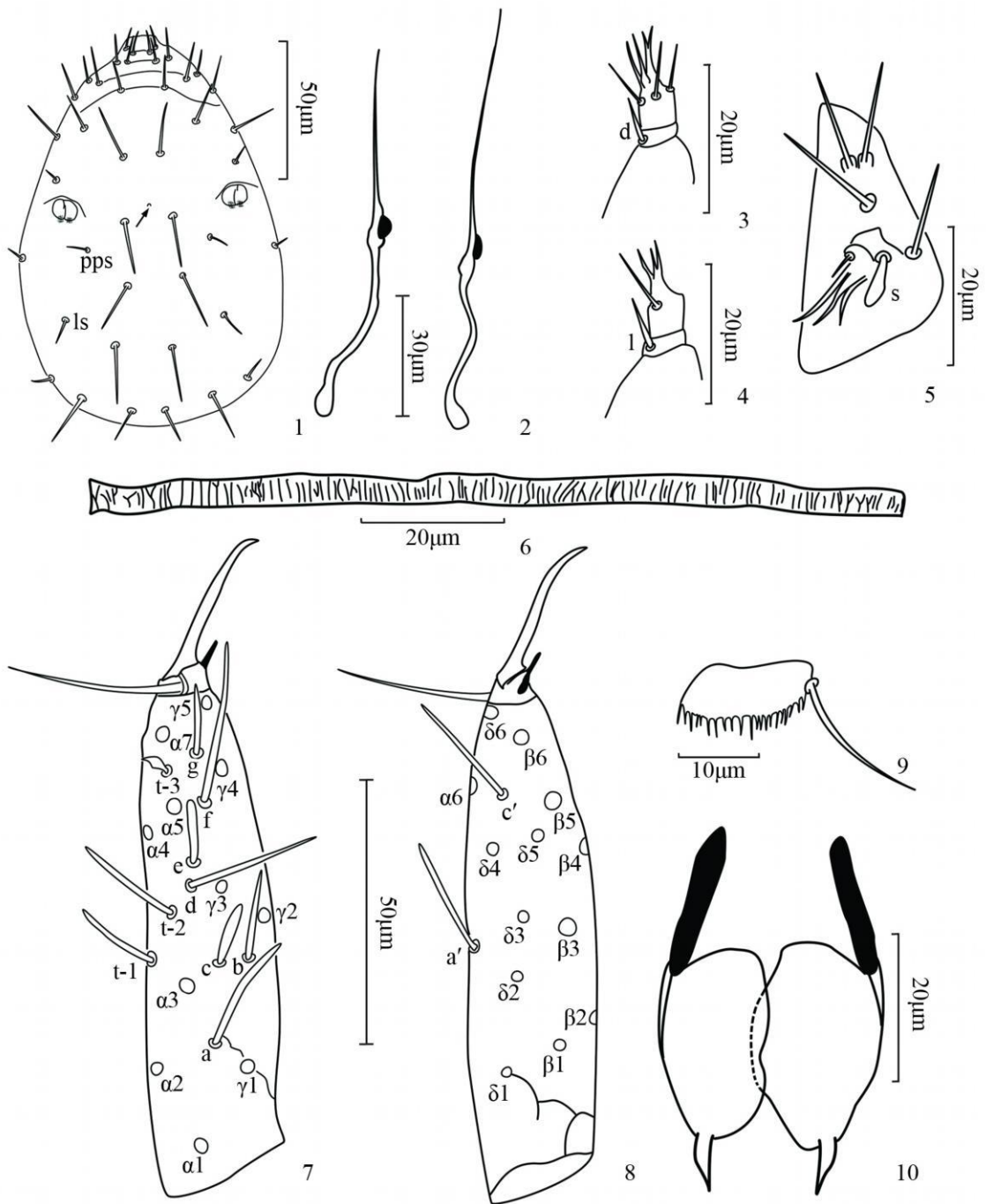
	Larva I		Larva II		Maturus Junior		Imago	
	Formula	Composition of Setae	Formula	Complementary Setae	Formula	Complementary Setae	Formula	Complementary Setae
Dorsal								
Thorax I	4	1, 2	4		4		4	
II - III	$\frac{4}{10}$	<i>A2, M</i> <i>P1, 2, 3, 4, 5a</i>	$\frac{6}{12}$	<i>A4</i> <i>P5</i>	$\frac{6}{14 (16)}$	<i>P2a (1a)</i>	$\frac{6}{16}$	<i>P1a</i>
Abdomen I	$\frac{0}{8}$	<i>P1, 2, 3, 4</i>	$\frac{0}{10}$	<i>P5</i>	$\frac{6}{10}$	<i>A1, 2, 5</i>	$\frac{6}{10}$	
II - III	$\frac{0}{10}$	<i>P1, 2, 3, 4, 5</i>	$\frac{0}{12}$	<i>P2a</i>	$\frac{6}{12}$	<i>A1, 2, 5</i>	$\frac{8}{12}$	<i>A4</i>
IV - VI	$\frac{0}{10}$	<i>P1, 2, 3, 4, 5</i>	$\frac{0}{14}$	<i>P2a, 4a</i>	$\frac{6}{14}$	<i>A1, 2, 5</i>	$\frac{8}{14}$	<i>A4</i>
VII	$\frac{0}{10}$	<i>P1, 2, 3, 4, 5</i>	$\frac{0}{14}$	<i>P2a, 4a</i>	$\frac{6}{16}$	<i>A1, 4, 5</i> <i>P1a</i>	$\frac{8}{16}$	<i>A3</i>
VIII	$\frac{0-6}{6}$	<i>M2, 3, 4</i> <i>P2, 3, 5</i>	$\frac{2-9}{6}$	<i>A5, Mc, 5</i>	$\frac{8-9}{6}$	<i>A2, 3, 4</i>	$\frac{8-9}{6}$	
IX			8	1, 2, 3, 4	10	1, 2, 3, 4, 5	12	1a
X					8	1, 2, 4, 5	10	3
XI					6	1, 2, 3	6	
XII	9		9		9		9	
Ventral								
Thorax I	$\frac{2-2}{4}$	<i>A1, M1</i> <i>P1, 2</i>	$\frac{2-2}{4}$		$\frac{2-4}{6}$	<i>M2</i> <i>P3</i>	$\frac{2-4}{6}$	
II	$\frac{5-0}{2}$	<i>Ac, 2, 3</i> <i>P1</i>	$\frac{5-2}{2}$	<i>M</i>	$\frac{5-2}{4}$	<i>P2</i>	$\frac{5-2}{4}$	
III	$\frac{5-0}{2}$	<i>Ac, 2, 3</i> <i>P1</i>	$\frac{5-2}{2}$	<i>M</i>	$\frac{7-2}{4}$	<i>A4</i> <i>P2</i>	$\frac{7-2}{4}$	
Abdomen I	$\frac{0}{2}$	<i>P1</i>	$\frac{3}{2}$	<i>Ac, 2</i>	$\frac{3}{2}$		$\frac{3}{2}$	
II - III	$\frac{0}{3}$	<i>Pc, 3</i>	$\frac{1}{5}$	<i>Ac</i> <i>P2</i>	$\frac{3}{5}$	<i>A2</i>	$\frac{3}{5}$	
IV - VI	$\frac{1}{4}$	<i>Ac</i> <i>P1, 2</i>	$\frac{1}{6}$	<i>P3</i>	$\frac{3}{8}$	<i>A2</i> <i>P1a</i>	$\frac{3}{8}$	
VII	$\frac{1}{4}$	<i>Ac</i> <i>P1, 2</i>	$\frac{1}{6}$	<i>P3</i>	$\frac{3}{8}$	<i>A2</i> <i>P1a</i>	$\frac{3}{8 (9)}$	(<i>Pc</i>)
VIII	$\frac{2}{0}$	<i>A1</i>	$\frac{4}{0}$	<i>A2</i>	$\frac{4}{2}$	<i>P1</i>	$\frac{4}{2}$	
IX			4		4		4	
X					4		4	
XI					2	2	6	1, 3
XII	8		8		6		6	

urostemites Segment XI with 3 + 3 short setae on urotergite and setae 1 and 3 on urostemite long Single middle pore present on the urotergite XII, and paired pores also present on urostemite XII Female squama genitalis with pointed acrostyli (Fig 10).

Younger instars The measurements and indices of younger instars as show in the Table 3

Chaetal variability. Larva I: no variability observed Larva II: urostemites II -III lack seta *Ac* (Nos NX-LP-P08042 NX-LP-P08043 NX-LP-

P08044). Maturus Junior mesonotum and metanotum asymmetrically with seta *P1a* at one side with 6/15 chaetotaxy (Nos NX-LP-P08033 NX-LP-P08034 NX-LP-P08035), urotergite VII asymmetrically with seta *A2* at one side with 7/16 chaetotaxy (No NX-LP-P08034). Preimag mesonotum and metanotum asymmetrically lack seta *P1a* at one side with 6/15 chaetotaxy (Nos NX-LP-P08030 NX-LP-P08181). Imago urotergite I with seta *P1a* with 6/12 chaetotaxy (Nos NX-LP-



Figs 1-10 *Huashanentulus huashanensis* Yin, 1980. 1 Head dorsal view (arrow show them middle pore). 2 Canal of maxillary gland 3 Maxillary papus dorsal view. 4 Maxillary papus lateral view. 5 Labium, exterior view. 6 Striate band on abdominal segment VIII. 7. Foretarsus exterior view. 8 Foretarsus interior view. 9. Comb on abdominal VIII. 10 Female squama genitalis

P08302, NX-LP-P08303, NX-LP-P08308), urotergite III with seta *P* 4a, with 8/14 chaetotaxy (No NX-LP-P08314), urotergite VI with seta *P* 1a, with 8/16 chaetotaxy (Nos NX-LP-P08302, NX-LP-P08303, NX-LP-P08308, NX-LP-P08314), urotergites II-VI with 8/16 chaetotaxy, each with setae *P* 1a and *P* 4a (observed in 3 females and 1 males from Taizimountain, Linxia Gansu).

Distribution China (Ningxia, Shaanxi, Gansu,

Sichuan, Hubei).

Remarks The helmet-like appendix on the calyx of maxillary gland is an important character of *Acerentomidae*. This structure was mentioned in the original description of *H. huashanensis*, but not showed in the figures because the angle of the specimen mounted on the slides. In this paper, we observed distinctive helmet-like appendix in many specimens, so we modified the drawing of maxillary gland. In addition,

Table 3 Body measurements (in μm) and indices of the younger instars

	Preimago	Maunus junior	Larva II	Larva I
Head length	128-130	125	110-118	95-98
Pseudoculus	7.5	7.5	6.3-7.5	6.3-7.5
PR	16.0-17.3	16.7	15.7-18.8	12.7
Maxillary gland	30	30	23-28	18-20
CF	4.0-4.4	4.2	4.1-4.9	4.8-5.4
MesonotalP 1	17-18	16-17	15-16	10-11
MesonotalP 1a	7-8	7-8	-	-
MesonotalP 2	25-28	23-25	20-21	14-15
Foretarsus	83-90	83-85	63-73	55-58
BS	0.74-0.89	0.7-0.83	0.71-0.87	0.57-0.77
Claw	18-23	20	18-20	13-15
TR	4.1-4.7	4.1-4.3	3.4-4.2	3.7-4.8
Empodium	5	5	5	2.5-3.8
EU	0.25-0.29	0.25	0.25-0.29	0.17-0.20
Middle tarsus	38-40	40	33-35	30
Middle claw	15-18	13	13	13
hind tarsus	43-45	43	35-40	33
hind claw	18-29	15	15-18	15
Body length	1 163-1 238	1 125-1 188	838-1 000	675-775
No. of specimens examined	5	5	5	5

the larva I , larva II and preimago was not described in the past because of shortage of specimens in this paper we supplement the information of these younger stars Also the pores on the body were described

Huashanentulus liupanensis sp. nov. (Figs 11-22)
Holotype female (No NX-LP-P08085), Ningxia Jingyuan Dongshanpo forest fam (35°35'N, 106°14'E; alt 2300m), from coniferous forest of Liupanmountain 23 June 2008 Paratypes 2 females (Nos NX-LP-P08182, NX-LP-P08183), Ningxia Guyuan Luyuan Forest Fam (35°45'N, 106°12'E; alt 2234 m), from coniferous forest of LiupanMountain 1 July 2008 1 female (No NX-LP-P08224), Ningxia Jingyuan Erlonghe Forest Fam (35°22'N, 106°16'E; alt 2200 m), from broad-leaved forest of LiupanMountain 3 July 2008. 1 female (No NX-LP-P08228), Ningxia Pengyang Guanagou forest fam (35°46'N, 106°20'E; alt 2227 m), from broad-leaved forest of Liupan Mountain 9 July 2008 1 larva II (No NX-LP-P08048), Ningxia Longde Sutai Forest Fam (35°26'N, 106°11'E; alt 2150 m), from broad-leaved forest of Liupan mountain 21 June 2008. All type specimens were collected by Mr HUANG ChengWang and BU Yun deposited in Shanghai EntomologicalMuseum (SEM).

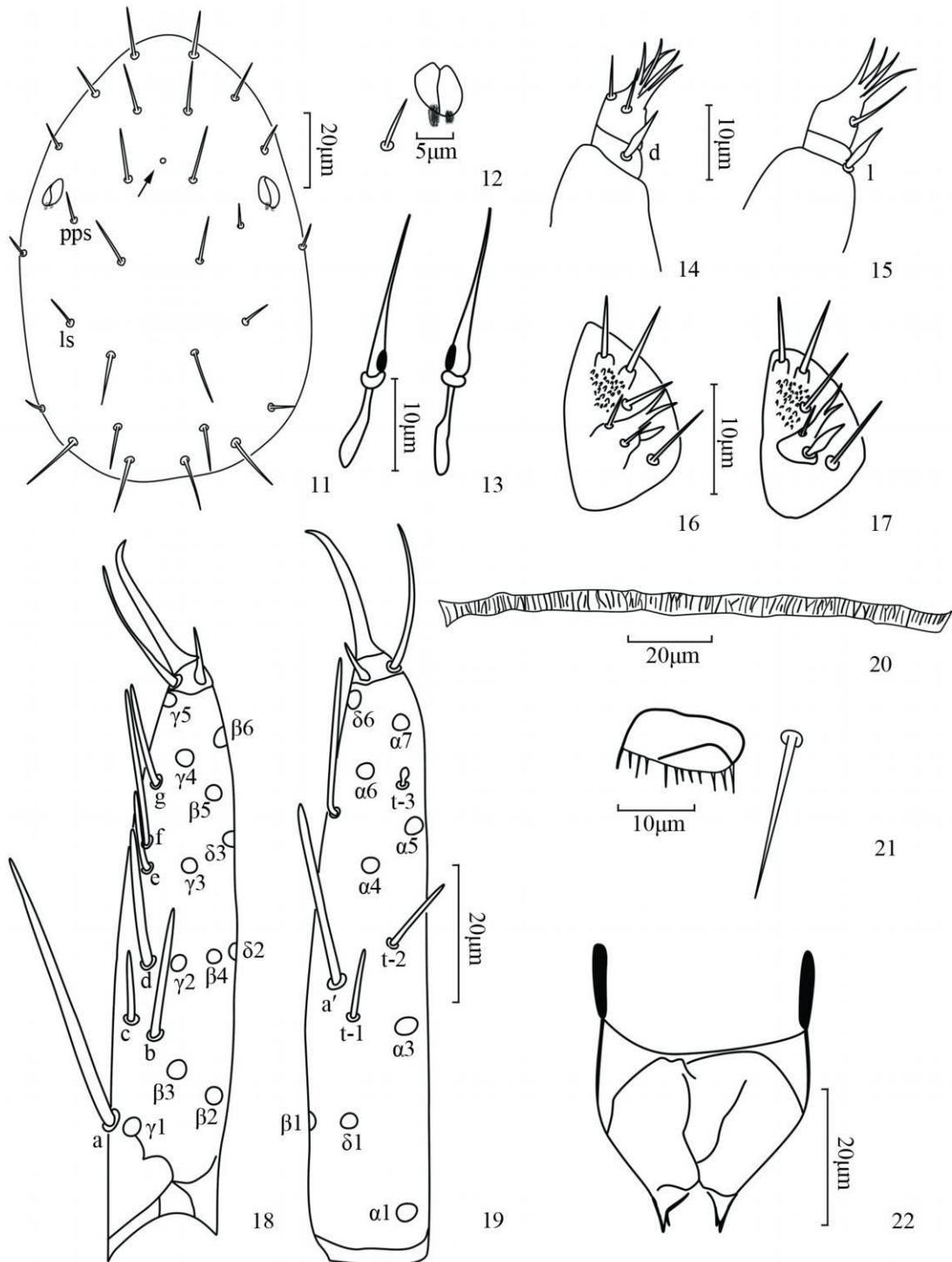
Diagnosis The new species *H. liupanensis* sp. nov. is characterized by the short maxillary gland, extremely long sensillum *a* on the foretarsus and granules on the labial region

Description Adult Body length 1 113-1 300 μm ($n = 5$).

Head Elliptic, length 115-120 μm , width 76-86 μm ($n = 5$), with one anterior middle pore Postpseudocular seta present Additional seta absent (Fig 11). Pseudoculus length 7-8 μm , width 6-7 μm . PR = 14.3-16.4 (Fig 12). Canal of maxillary gland short with posterior part bulked Calyx smooth with one helmet like appendix Posterior filament of maxillary gland length 13-14 μm . CF = 9.6-11.5 (Fig 13). Maxillary palp with two sensilla subequal (Figs 14-15). Labial palp well developed with apical tuft and one leaf like sensillum. The articles anterior to the base of Labial palp decorated with some granules (Figs 16-17).

Thorax Chaetotaxy as shown in Table 4 Mesonotum and metanotum with 2 pairs of anterior seta (*A* 2 and *A* 4), seta *P* 1a absent seta *P* 2a short and small and seta *P* 5a short cone-shaped Length ratio of *P* 1 : *P* 2 on mesonotum as 1.0 : 1.2-1.5 Pronotum with no pores mesonotum and metanotum with pore *l* and *al* Stema of thorax without pore

Foretarsal length 81-86 μm , claw length 19-21 μm TR = 4.1-4.3 Empodium length 4 μm , EU = 0.20-0.21. Dorsal sensillum *t*-1 short, filiform, BS = 0.65-0.73 *t*-2 thin; *t*-3 very small knob-shaped Exterior sensillum *a* extremely long and robust reaching base of *f*, *b* filiform, slightly surpassing base of γ 2; *c* short and slim, about half length of *b*; *d* slightly broad and long nearer to *c* than to *e*



Figs 11–22 *Huashanentulus liupanensis* sp. nov. 11. Head dorsal view (arrow show the middle pore). 12. Pseudoculus. 13. Canal of maxillary gland. 14. Maxillary palpus dorsal view. 15. Maxillary palpus lateral view. 16. Labium, interior view. 17. Labium, exterior view. 18. Foretarsus exterior view. 19. Foretarsus interior view. 20. Striate band on abdominal segment VIII. 21. Comb on abdominal VIII. 22. Female squama genitalis.

sensillum *e* short and slim, *f* filiform, reaching base of claw; *g* short and slim (Fig 18). Interior sensillum *a'* thick distal to *t*-1 (Fig 18); *b'* absent; *c'* thin and long its apex reaching base of claw (Fig 19). Setae $\delta 4$ and $\beta 1$ in normal shape. Length formula of foretarsal sensilla as $t-3 < c < e = t-1 = t-2 < g < b$

$< d < f = c' < a' < a$ (Figs 18-19). Middle tarsal length 33-35 μm , claw length 18-20 μm . Hind tarsal length 36-40 μm , claw length 18-23 μm .

Abdomen Chaetotaxy as shown in Table 4. Urotergite I with 2 pairs of anterior seta (*A* 1, *A* 2), with 5 pairs of posterior seta; seta *P* 1a absent.

Urotergites II -VI with 3 pairs of anterior seta, 6 pairs of posterior seta, setae *P 1a* and *P 2a* lacked. Seta *P 3* on urotergite II -VI situated anterior to level of *P 2*. Urotergite VII with 8 pairs of posterior seta. *P 1a* and *P 2a* present. Accessory setae on urotergites II -VII short hair-like. Urotergite I with pore *pm*, other pores absent. Urotergites II -VI with pores al and *pm*. Urotergite VII with pore *pm*.

Abdominal legs II -III with 2 subequal setae, the ratio of subapical seta and apical seta as 1.0: 1.1. Accessory setae on urosternites I -VII short hair-like.

Urosternites I -III without pores. Urosternites IV -VII each with one asymmetrically pore *pm*. Striate band on abdominal segment VIII well developed (Fig. 20). Segment VIII with paired pore *pm* on urotergite, without pores on urosternite. Comb on abdomen VIII rectangular, with 9-12 similar teeth on hind margin (Fig. 21).

Segments IX -XI each with some teeth on the hind margin. Segments IX -XI without pores on urotergites and urosternites. Segment XI with 3+ 3 short setae on urotergite, and setae 1 and 3 on urosternite long.

Table 4 Chaetotaxy of *Huashanentulus liupanensis* sp. nov.

	Larva II		Imago	
	Formula	Composition of Setae	Formula	Composition of Setae
Dorsal				
Thorax I	4	1, 2	4	1, 2
II	$\frac{6}{12}$	<i>A 2, 4 M</i> <i>P 1, 2, 3, 4, 5, 5a</i>	$\frac{6}{14}$	<i>A 2, 4 M</i> <i>P 1, 2, 2a, 3, 4, 5, 5a</i>
III	$\frac{6}{12}$	<i>A 2, 4 M</i> <i>P 1, 2, 3, 4, 5, 5a</i>	$\frac{6}{14}$	<i>A 2, 4 M</i> <i>P 1, 2, 2a, 3, 4, 5, 5a</i>
Abdomen I	$\frac{0}{8}$	<i>P 1, 2, 3, 4</i>	$\frac{4}{10}$	<i>A 1, 2</i> <i>P 1, 2, 3, 4, 5</i>
II -VI	$\frac{0}{12}$	<i>P 1, 2, 3, 4, 4a, 5</i>	$\frac{6}{12}$	<i>A 1, 2, 5</i> <i>P 1, 2, 3, 4, 4a, 5</i>
VII	$\frac{0}{14}$	<i>P 1, 1a, 2, 3, 4, 4a, 5</i>	$\frac{6}{16}$	<i>A 1, 2, 5</i> <i>P 1, 1a, 2, 2a, 3, 4, 4a, 5</i>
VIII	$\frac{2-6}{6}$	<i>A 3, M 2, 3, 4</i> <i>P 2, 3, 4</i>	$\frac{6-7}{8}$	<i>A 2, 4, 5, M 5, 2, 3, 4</i> <i>P 2, 3, 4, 5</i>
IX			12	1, 1a, 2, 2a, 3, 4
X			10	1, 2, 2a, 3, 4
XI	8		6	
XII	9		9	
Ventral				
Thorax I	$\frac{2-2}{4}$	<i>A 1, M 1</i> <i>P 1, 2</i>	$\frac{2-4}{6}$	<i>A 1, M 1, 2</i> <i>P 1, 2, 3</i>
II	$\frac{5-2}{2}$	<i>A 5, 2, 3 M</i> <i>P 1</i>	$\frac{5-2}{4}$	<i>A 5, 2, 3, M</i> <i>P 1, 2</i>
III	$\frac{5-2}{2}$	<i>A 5, 2, 3 M</i> <i>P 1</i>	$\frac{7-2}{4}$	<i>A 5, 2, 3, 4 M</i> <i>P 1, 2</i>
Abdomen I	$\frac{2}{2}$	2 <i>P 1</i>	$\frac{3}{2}$	<i>A 5, 2</i> <i>P 1</i>
II -III	$\frac{1}{3}$	<i>A c</i> <i>P 5, 2</i>	$\frac{3}{5}$	<i>A 5, 2</i> <i>P 5, 2, 3</i>
IV -VI	$\frac{1}{6}$	<i>A c</i> <i>P 1, 2, 3</i>	$\frac{3}{8}$	<i>A 5, 2</i> <i>P 1, 1a, 2, 3</i>
VII	$\frac{1}{6}$	<i>A c</i> <i>P 1, 2, 3</i>	$\frac{3}{9}$	<i>A c 2</i> <i>P 5, 1, 1a, 2, 3</i>
VIII	4	1, 2	4	1, 2
IX	4		4	
X			4	
XI			6	
XII	6		6	

Table 5 Differences between *H. liupanensis* sp. nov. and *H. huashanensis* Yin 1980

Characters	<i>H. liupanensis</i> sp. nov.	<i>H. huashanensis</i> Yin 1980
Proximal part of maxillary gland	Broad and short	Slim and long
Sensillum t-3 on foretarsus	Knob-like	Lanceolate
Sensillum a on foretarsus	Extremely long	Normal
Anterior setae of urotergites II-VI	3 pairs	4 pairs
Posterior setae of urotergites II-III	<i>P</i> 1 <i>a</i> , <i>P</i> 2 <i>a</i> lacked	<i>P</i> 1 <i>a</i> , <i>P</i> 4 <i>a</i> lacked
Posterior setae of urotergites IV-VI	<i>P</i> 1 <i>a</i> , <i>P</i> 2 <i>a</i> lacked	<i>P</i> 1 <i>a</i> lacked
Chaetotaxy of urostemite VIII	4/0	4/2
Chaetotaxy of urostemite VII	3/9	3/8 (9)
Comb on abdominal segment VIII	With 9-12 teeth	With 20-22 teeth

Single middle pore present on the urotergite XII, and paired pores *al* also present on urostemite XII.

Female squama genitalis with pointed acrostyli (Fig. 22).

Younger instars Larva II: body length 798 μ m ($n = 1$). Head length 100 μ m, width 68 μ m. Pseudoculus length 6 μ m, width 6 μ m, PR = 16.7. Posterior filament of maxillary gland length 9 μ m. CF = 11.1. Fortarsal length 65 μ m; claw length 13 μ m; TR = 5; Empodium length 3 μ m, EU = 0.23; BS = 0.77; middle tarsal length 33 μ m, claw length 15 μ m. Hind tarsal length 35 μ m, claw length 16 μ m. Chaetotaxy as shown in Table 4. Other younger instars unknown.

Distribution China Ningxia
Etymology The species name derived from the name of Liupan Mountain where the type specimens being collected.

Remarks Only one species described in genus *Huashanentulus*, here we described the second species *H. liupanensis* sp. nov. The present new species with distinct helmet-like appendix on Calyx of maxillary, well developed labial pulp, filiform sensillum t-1 on foretarsus and two pairs of anterior seta on mesonotum and metanotum, which indicate it is a member of Tuxenentulinae. This species can be easily distinguished from *huashanensis* by the shape of maxillary gland sensilla on foretarsus, the chaetotaxy on the body and the female genitalis (Table 5). The granule on the cuticles of labial region is a special character observed in Protura.

List of Protura from Liupan Mountain, Northwest China

The abbreviation Mj = matured junior, LII = larva II, LI = larva I. All specimens were collected by Mrs. LUAN Yun-Xia, GAO Yan and Mr. HUANG Cheng-Wang, CHEN Wan-Jun, BU Yun.

***Hesperentomon chinghaiensis* Yin, 1982**

Known from Qinghai, Sichuan, Yunnan, Hubei and Gansu Provinces.
Material examined Ningxia Province:

Dongshanpo 2 females, Fengtai 1 female, 1 m.j. Heshangpu 1 female, Qiuqianjia 1 female, 1 male, 1 m.j. Hongxia 1 L.II.

***Hesperentomon pectigastulum* Yin, 1984**

Known from Shanxi, Hebei and Shaanxi Provinces.
Material examined Ningxia Province: Shatang 2 females, Sutai 1 female, Dongshanpo 1 female, Heshangpu 3 females, 2 m.j. 1 L.I, Longtan 2 females, Hongxia 2 m.j.

***Proturentomon chinensis* Yin, 1984**

Known from Shanxi, Hebei, Shandong, Liaoning and Neimenggu Provinces.
Material examined Ningxia Province: Shatang 2 females, Dongshanpo 1 female, Guomagou 2 females.

***Baculentulus tianmushanensis* Yin, 1963**

Known from Zhejiang, Shanghai, Jiangxi, Anhui, Hubei, Hunan, Sichuan, Chongqing, Guizhou, Yunnan, Henan, Hebei, Liaoning, Neimenggu and Shaanxi Provinces.
Material examined Ningxia Province: Shatang 2 females, 2 m.j.

***Kenentulus henanensis* Yin, 1983**

Known from Henan, Zhejiang, Jiangxi, Hubei, Guizhou, Yunnan and Hainan Provinces.
Material examined Ningxia Province: Shatang 2 females.

***Kenentulus jiuzhaiensis* Tang et Yin, 1986**

Known from Sichuan and Gansu Provinces.
Material examined Ningxia Province: Sutai 2 females, Dongshanpo 1 female, Qiuqianjia 1 female, 1 male, 1 m.j. Longtan, 7 females, 2 males, Erbinghe 1 m.j. Hongxia 1 female, 1 male.

***Huashanentulus huashanensis* Yin, 1980**

Known from Shaanxi, Gansu, Sichuan and Hubei Provinces.
Material examined Ningxia Province: see the description above.

Huashanentulus lupanensis sp. nov.

Known from Ningxia Province

Material examined Ningxia Province, see the description above

Nosekiella sinensis Bu et Yin, 2008

Known from Qinghai Ningxia and Shaanxi Provinces

Material examined Ningxia Province Heshangpu, 1 female Guinagou, 1 female Erlonghe, 4 females, 1 preimag, 4mj, 1 LII.

Fujianentomon dicestum Yin, 1977

Known from Shanghai Zhejiang Jiangsu Anhui Henan and Yunnan Provinces

Material examined Ningxia Province Shatang, 1 male

Eosentomon orientalis Yin, 1979

Known from Shanghai Jiangsu Zhejiang Anhui Jiangxi Hunan Hubei Sichuan Chongqing Guizhou Guangxi Guangdong Hainan Liaoning Qinghai and Shaanxi Provinces

Material examined Ningxia Province Shatang, 2 females, 2 males, 1 LII, Sutai, 3 females, 1 male Heshangpu, 1 female Qiuqianjia, 2 females Longtan, 1 male

Eosentomon megalenum Yin, 1989

Known from Shanghai Jiangsu Shaanxi Yunnan Guizhou Hubei Hunan and Sichuan Provinces

Material examined Ningxia Province Shatang, 1 female Sutai, 1 male Qiuqianjia, 1 female, 1 male

Eosentomon asahi Imadaté, 1961

Known from China (Qinghai Heilongjiang Jilin Liaoning Nei Monggu Beijing) and Japan

Material examined Ningxia Province Sutai, 3 females Woyangdunar, 1 female Qiuqianjia, 3 females Longtan, 1 female, 1mj Hongxia, 1mj

Pseudanisetomon trilineum Zhang et Yin, 1981

Known from Guangxi Guangdong Fujian Jiangxi Guizhou Sichuan and Yunnan Provinces

Material examined Ningxia Province Guinagou, 1 female

Pseudanisetomon minyistignum Yin, 1979

Known from Shanghai Jiangsu Zhejiang Anhui Fujian Hubei and Yunnan Provinces

Material examined Ningxia Province Shatang, 1 female, 1 male

Acknowledgements We give our cordial gratitude to Mr. XIE Rong-Dong and YANG Yim-ing for their instruction in identification. We also sincerely thank Dr. LUAN Yun-Xia, GAO Yan, CHEN Wan-Jun and Mr. HUANG Cheng-Wang for their help in the collection. Thanks are also giving to Professor REN Guo-Dong from Hebei University for his invitation to the expeditions.

REFERENCES

- Bu, Y. and Yin, W.-Y. 2007. Two new species of *Hesperentomon* Price, 1960 from Qinghai Province, Northwestem China (Protura: Hesperentomidae). *Acta Zootaxonomica Sinica*, 32 (3): 508-514 [动物分类学报].
- Bu, Y. and Yin, W.-Y. 2008. Occurrence of *Nosekiella* and *Ninna* (Protura: Nipponentomidae) in China. *Annales de la Société Entomologique de France*, 44 (2): 201-207.
- Yin, W.-Y. 1980. Studies on Chinese Protura: Description of new species and new genera of the family Acerentomidae with discussions on their phylogenetic significance. *Contributions from Shanghai Institute of Entomology*, 1: 135-156.
- Yin, W.-Y. 1999. Fauna Sinica Arthropoda Protura. Science Press Beijing, 510 pp.

中国西北六盘山区原尾虫研究

卜云 尹文英

中国科学院上海生命科学研究院植物生理生态研究所 上海 200032

摘要 通过研究中国西北六盘山区采集到的原尾虫标本, 对华山虱 *Huashanentulus huashanensis* Yin, 1980 进行了重新描述, 补充了第 I 幼虫、第 II 幼虫和前成虫的描述, 重新描绘了颧腺结构图, 并描述了体表腺孔。同时记述华山虱属 1 新种, 六盘华山虱 *Huashanentulus lupanensis* sp. nov., 新种的主要特征是颧腺管粗短, 前足跗节上感器 a 极长大, 并与华山虱进行了比较区别。文中列出了六盘山区原尾虫的种类名录, 共包括 15 种, 分别是青海夕虱 *Hesperentomon dinghaiensis* Yin, 1982, 棘腹夕虱 *H. pedigastrum* Yin, 1984, 中国原虱 *Proturanton chinensis* Yin, 1984, 天目巴虱 *Baocentulus*

关键词 原尾虫, 新种, 六盘山, 中国.

中图分类号 Q969.11

tianmushanensis Yin, 1963, 河南肯虱 *Kenentulus henanensis* Yin, 1983, 九寨肯虱 *K. jiuzaensis* Tang et Yin, 1986, 华山虱 *Huashanentulus huashanensis* Yin, 1980, 六盘华山虱 *H. lupanensis* sp. nov., 中华诺虱 *Nosekiella sinensis* Bu et Yin, 2008, 双腰富虱 *Fujianentomon dicestum* Yin, 1977, 东方古虱 *Eosentomon orientalis* Yin, 1965, 大眼古虱 *E. megalenum* Yin, 1989, 日升古虱 *E. asahi* Imadaté, 1961, 三纹拟异虱 *Pseudanisetomon trilineum* Zhang et Yin, 1981, 小孔拟异虱 *P. minyistignum* Yin, 1979. 新种模式标本保存在上海昆虫博物馆。